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# PATENT SPECIFICATION

1,078,462

DRAWINGS ATTACHED.

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Int. Cl.:—D 04 b //A 41 d.

## COMPLETE SPECIFICATION.

### Method of Manufacture of Fashioned Knitted Garments, Machine for Carrying Out this Method and Garment Obtained by this Method.

We, ETUDES ET BONNETERIE S.A., a Corporation organized under the laws of Switzerland, of 4, rue du Lion d'Or, Lausanne, Switzerland, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with the manufacture of a fashioned knitted garment having at least one tubular part and non tubular parts.

It is known to manufacture garments, such as slips, bathing tights or costumes, singlets, brassieres, etc. by knitting separate fashioned parts and then joining them by sewing. This method is relatively slow, it requires complicated machinery, utilizable only by qualified workmen. That is why such a method remains practically reserved for the exclusive knitting of luxury articles. Furthermore, the articles thus obtained have the disadvantage of having side-seams.

According to this invention in one aspect there is provided a method of manufacturing a knitted garment having at least one tubular part and fashioned non tubular parts, said method being characterized by the steps of knitting said tubular part of the garment in circular continuous process on a circular knitting machine which has at least two opposite knitting stations, and of knitting on said machine by a circular reciprocating process said non tubular parts suitably fashioned by narrowings by dropping stitches and by widenings by means of fresh stitches, said non tubular parts being knitted

simultaneously on separate knitting stations.

According to this invention in another aspect, there is provided a machine for carrying the method described in the preceding paragraph into effect, which machine comprises a needle cycliner, knitting cams controlling the vertical movement of the needles, means for changing the movement of the machine from continuous to reciprocating, and means for the automatic change of the loop quality, characterized by further including means for putting all the needles into action for continuously knitting the tubular parts of the garment and means for selectively putting needles and groups of needles into and out of action for knitting in a reciprocating manner profiled parts of the garment and, to this end, comprising four selection channels each corresponding to a specific position of the needles.

The invention further includes a knitted garment obtained by the above-mentioned method and characterized in that it is formed of one knitted piece comprising at least one tubular part integral with selvedge-shaped non tubular parts with widenings and/or narrowings formed respectively by fresh stitches and dropped stitches.

The accompanying drawing shows, by way of example, one embodiment of the method and of the machine for carrying out the method as well as several embodiments of the article obtained by this method.

Figures 1 to 3 are knitting diagrams,

Figure 4 is an axial section through one part of the circular knitting machine,

Figure 5 is an expanded view of the

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knitting cam devices of the machine shown in Fig. 4,

Figure 6 is a perspective view of the circular knitting machine,

5 Figures 7 and 9 are two modifications of details showing a special knitting operation,

Figures 8 and 10 are partial sections relative to the two modifications of fig. 7 and 9 respectively,

10 Figure 11 is a form of carrying out the method,

Figure 12 is a view in side elevation of the finished article according to a first embodiment,

15 Figure 13 is a view in front elevation of a second embodiment of the article,

Figure 14 is a view thereof in side elevation,

20 Figure 15 is an expanded view of a third embodiment of the article,

Figure 16 is a diagram of the distribution of the knitting pitches,

Figure 17 is a perspective view of this third embodiment,

25 Figure 18 is a view similar to fig. 15, of a fourth embodiment of the article, and

Figure 19 is a perspective view of this embodiment.

30 In the method which is to be described, one knits tubular parts continuously and non-tubular parts in a reciprocating manner of a garment to be manufactured on a circular knitting machine such as the one shown in figure 4. In order better to understand the various operations taking place in the method, there will first of all be described the main members of the machine which is basically of a known type but which comprises means for effectively permitting the carrying out of this method.

40 This machine comprises a needle cylinder 1 driven to rotate in a continuous or reciprocating manner through the agency of a toothed rim 2 gearing with a driving pinion not shown. For the clearness of the drawing, only a single needle has been shown for each of the fundamental positions  $A_1$ ,  $A_2$ ,  $A_3$  and  $A_4$  during the different phases of the knitting. It is obvious that these positions could be occupied by all the needles or only a part of the latter. Each needle includes a hook 3 with a latch 4 and a butt 5 adapted to be controlled by a knitting cam device  $B_1$  or  $B_2$ . These devices are diametrically opposite one another and each extends over half the circumference of the cylinder 1, having as shown in the developed view of figure 5 channels  $L_1$ ,  $L_2$ ,  $L_3$  and  $L_4$  corresponding to each of the characteristic positions  $A_1$ ,  $A_2$ ,  $A_3$  and  $A_4$  respectively in which engage the respective butts of the needles during the operation of the machine.

65 The device  $B_1$  comprises movable stitch cams 20 adapted at one time to raise the

needles to the knitting position and, at another time to make the needles pass from the channel  $L_3$  into the channel  $L_2$ ; cams 21 for returning the needles from the channel  $L_2$  into the channel  $L_3$ ; a cam 22 serving to transfer the needles selectively from the channel  $L_3$  to the channel  $L_4$ ; lifting pickers 23, 24, 26 and lowering pickers 25; cams 27 and 28 for making the needles pass from the channel  $L_3$  into the channel  $L_1$  and vice-versa and a cam 29 for returning the needles from the channel  $L_4$  into the channel  $L_3$ .

The device  $B_2$  includes the same cams 20, 21 as the device  $B_1$  as well as the lifting pickers 24, 26 and the lowering pickers 25, lowering pickers 30 being moreover mounted in order to return the needles from the channel  $L_1$  into the channel  $L_3$ .

85 The needles in position  $A_1$  are needles held over in the channel  $L_1$  during the knitting of partial rows upon the formation of a pocket or a gusset as will be described further on. These needles in position  $A_1$  keep their stitch under the latch.

90 Certain needles are brought occasionally into position  $A_2$  which corresponds to the channel  $L_2$ . They also keep their stitches under the latch.

95 The channel  $L_3$  which corresponds to the position  $A_3$  of the needles, is the working channel proper. The needles in this position carry the old stitch engaged on the shank under the latch and are ready to collect a new thread to form new stitches.

100 The needles brought into position  $A_4$  in the channel  $L_4$  have dropped their last stitch and are held temporarily out of operation.

105 In figure 6 one sees how are disposed and controlled the described lifting and lowering pickers, the same reference numbers designating the same members as in fig. 5. Each picker 23 to 26 and 30 is mounted on a hinged support  $S_{23}$  . . .  $S_{26}$  and  $S_{30}$  respectively carried by a respective pillar  $P_{23}$  . . .  $P_{26}$  and  $P_{30}$  fixed in a flange 135 surrounding the cylinder 1 of the machine.

110 Vertical rods 123, 124, 125, 126 and 130 are hooked to the free ends of the respective pickers and control the movements of these pickers into and out of operation.

115 The rod 123 controls the narrowing picker 23 used for moving the "reduced" needles to be held out of action from the channel  $L_2$  upon narrowings by means of dropped in detail with reference to figure 3.

120 The rods 124 and 125 control the narrowing pickers 24 and 25 serving to move the needles from the channel  $L_3$  into the channel  $L_4$  through the agency of channel  $L_2$  upon narrowings by means of dropped stitches as will be described in detail with reference to figure 1.

125 The rods 126 control the widening pickers 26 serving to return the needles from the 130

channel  $L_4$  to the channel  $L_3$  for the formation of new stitches as described with reference to figure 1.

5 The rod 130 controls the widening picker 30 to bring the needles from the channel  $L_1$  into the channel  $L_3$  upon retaking of the stitches held over as described with reference to figure 3.

10 The connecting rod 127 serves to actuate the cams 27 and 28. M designates the conventional sinker ring assembly, one of said sinkers  $M_3$  being shown in figure 4.

15 One will now describe different phases of the method by referring to the knitting diagrams of figures 1 to 3.

In the diagram of figure 1, one has shown the spread of a knitting zone E defined on the right by the curve R.S.T. and on the left by the profile M.N.O.P.Q. The knitting profile defined by these two curves is obtained, at one time by putting out of action a certain number of selvedge needles, and at another time putting the said needles again into service with this particular circumstance, that the needles when put out of action drop their respective stitches without gathering a new thread whereas the needles put again into service knit new stitches without any connection with the old dropped stitches. The selective control of the needles is effected by a conventional selecting mechanism not shown. The first knitted row will for convenience be designated  $E_1$  and the following rows  $E_2$ ,  $E_3$ , etc. In passing from the row  $E_1$  to the row  $E_2$  one puts out of operation the four needles at the right hand end and two needles at the left hand end. The passage from the row  $E_2$  to the row  $E_3$  is obtained by temporarily putting out of operation two further needles on the right and one only on the left. During successive phases of narrowing the different selected needles must each drop their last stitch as they are put out of operation. To this end, these needles are brought selectively to  $A_2$  by the lifting pickers 24 of the knitting cam devices  $B_1$  and  $B_2$ , a position in which as stated above, the old stitch slips under the latch after which these same needles are lowered at  $A_4$  under the action of the lowering pickers 25 before the needles next pass a knitting feed. During this phase, the needles drop their stitch and remain held over in the channel  $L_4$  until a new selection causes their return to action. This return is ensured by the lifting pickers 26 or by the cam 29 which as stated bring back the needles from the channel  $L_4$  into the channel  $L_3$  for the formation of new stitches.

60 It is thus, for example, that for the production of the row  $E_{2n}$ , the phase of narrowings on curve RST is replaced by a phase of successive widenings. To this end, the needles o, n, m, l, etc. in the channel  $L_4$

are brought again into action in the channel  $L_3$  by the lifting pickers 26 for the formation of new stitches, this according to the selection provided for the rows  $E_{20}$ ,  $E_{22}$ ,  $E_{24}$ , etc. The production of the knitted zone E on the circular machine of figure 4 is performed by reciprocating knitting, that is to say that the cylinder 1 or the cam devices  $B_1$  and  $B_2$  effect an oscillating movement according to known technique.

In the diagram of figure 2 one has shown a strengthening zone R on a knitted piece U. As shown in fig. 7, the knitted piece U is formed by means of a single ground yarn 101 and the strengthening zone R is obtained by the simultaneous knitting of the ground yarn 101 and a splicing yarn 102. To this end, the needles  $A_R$  selectively brought to a suitable level grip at the same time the ground yarn 101 and the splicing yarn 102, the control of the two threads being effected by means of a thread guide 103 with two holes.

In the modification of figures 9 and 10, a thread carrier 104 is moved from front to back so as to engage upon each of its strokes a predetermined number of needles in order to produce a strengthening zone of the desired width.

In the knitting diagram shown in figure 3, one considers that the knitting surface on which it is proposed to produce a pouch in relief, in particular a slip gusset or a breast pocket for a bathing costume or other knitted article, is defined within the rectangle A, B, C, D in which the knitted surface is shaded. A first tubular part including the complete rows 1, 2, 3 . . . 8 is knitted in jersey stitches joined by continuous rotation of the cylinder of the circular knitting machine. The row 9 is obtained during a reciprocating movement of the cylinder of the machine, leaving temporarily at rest the needles a, b, c, d, e, f, to the right and  $a^1$ ,  $b^1$ ,  $c^1$ ,  $d^1$ ,  $e^1$ ,  $f^1$  to the left. To this end, these needles are brought selectively into position  $A_1$  in the channel  $L_1$  by the cam 28, with their respective stitches formed during the knitting of the row 8 held under the latch 4.

In row 10, two fresh needles are brought out of operation into position  $A_1$  in the channel  $L_1$  by means of the lifting or narrowing pickers 23 and with their stitches retained under the latch. At each new row, such as 11, 12 some needles are put out of operation keeping their respective stitches retained under the latch. One thus obtains a non-tubular part of a preliminary shape by narrowings with stitches awaiting knitting or "false" narrowings.

After completion of said narrowings, the operation cycle is reversed by selectively bringing back into the working position, by successive stages under the action of the 130

lowering pickers 30 or *en block* by putting the cam 27 into service, the waiting needles from the channel  $L_1$  into the channel  $L_2$ . One thus obtains widenings such as 13 to 16 by taking up of the waiting stitches which in joining up with the new stitches determine the beginning of a pouch in relief. According to the importance of the pouch to be obtained, the operation which has just been described relative to the narrowings followed by widenings will be repeated a certain number of times, the law of narrowings and widenings varying according to the profile which it is desired to give to the pouch.

In order to manufacture a proportioned garment, as shown in figure 11, for example, briefs for men, one knits on the one hand, continuously a tubular part 31 of a preliminary shape on the circular knitting machine with two cam devices  $B_1$ ,  $B_2$ , by employing all the needles brought back by the cam 29, and on the other hand, in reciprocating fashion on this same machine front and rear non tubular parts 32, 33 of this preliminary shape, these latter parts being knitted with narrowings by dropped stitches and widenings by taken-up stitches as described with reference to fig. 1. 34 designates a separating course which one inserts during the knitting and the role of which will be described further on. One continues the knitting of a new preliminary shape shown in dot and dash lines by forming first of all the non tubular parts 35, 36 and then the tubular part 37 up to a separating course such as 31' from the following preliminary shape and so on so as to obtain a string of symmetrical preliminary shapes in head to foot formation relative to the joining lines.

Figure 12 shows the finished slip, obtained by looping or seaming the end courses of the crotch as indicated at 38 and finally pulling away the separation courses 31' and 34.

Figures 13 and 14 show, in front and profile respectively, a pair of briefs for a man in which the tubular part has a strengthening zone 40 extending into the non tubular part 41 up to the crutch. The strengthening 40 has a gusset 42 produced as described with reference to fig. 3, 42' designating the so-called suture lines formed during the widenings by taking up the waiting stitches resulting from the false narrowings.

In the knitting of the described briefs, the amplitude of the reciprocating movements of the cylinder will be determined as a function of the setting on the cam device  $B_1$  or  $B_2$  of the different knitting and selection elements. In the case under consideration, this amplitude exceeding  $180^\circ$ , it is necessary to avoid the possible interference with the needles in a knitting station by

needles selectively controlled for knitting to the other station. To this end, the stitch cams 20 serve to engage the first border needles in the waiting channel  $L_2$ . These needles will be replaced in working position in the channel  $L_3$  during their passage under the cams 21.

The needles corresponding to the side openings of the slip defined by the points a, b, and  $a_1$ ,  $b_1$  must remain inoperative during the whole of the knitting of the front and rear non tubular parts. These needles must also abandon their respective stitches in accordance with the law of fashioning. To this end, these needles are transferred selectively under the action of the cam 22 into the channel  $L_2$ , then to be brought back again into the channel  $L_3$  where they will remain waiting until the following preliminary shape is taken up. These operations proceed simultaneously or separately on the two respective knitting stations according to the profile of the article. The only operations still necessary for finishing the article consist in adding the belt and in binding the two side openings, the crutch joint being formed by the linking or looping course x y as already described.

The lady's bathing costume shown expanded in figure 15 may be decomposed into four superposed knitting zones I, II, III and IV produced with eight knitting stations distributed as shown in the diagram of fig. 16. It is to be understood by "knitting station" or "pitch" is meant all the elements permitting the knitting of a series of stitches. In zone I, one meets again with a knitting profile similar to that of the front and rear non tubular parts of the briefs described above. The knitting in this zone will be carried out in reciprocating fashion on the knitting stations 1 and 2 simultaneously, the stitching stations 3 to 8 remaining temporarily out of knitting.

Zone II corresponds to the tubular part of the article. It is knitted with the machine rotating continuously and the eight knitting stations are put simultaneously into service. As regards the curve, in the zone Z indicating the waist of the bathing costume, it is obtained by changing the loop quality in known manner.

Zone III is a non tubular part knitted in reciprocating fashion and having breast pockets 3, 4 knitted according to the method described with reference to figure 3. For this zone III, one employs the four knitting stations 3—4; 5—6. The breast pockets 3, 4 are knitted selectively on the knitting stations 3 and 4 respectively, the knitting stations 5 and 6 being left out of knitting during the production of the partial rows such as 9 to 15 of fig. 3. These knitting stations 5 and 6 will enter again into action

upon production of the complete rows of stitches such as 6 to 8 or 32 to 34, etc.

For the knitting of zone IV, one will employ the same method as for zone I. However for the four straps, one will employ the four knitting stations 3, 4, 5 and 6 with the same knitting method as that described with reference to fig. 1. The finished bathing costume is shown in fig. 17, the straps having been joined by a non visible linking thread as well as the connection between the parts 1 and 2.

Figure 18 shows in expanded form a singlet comprising two superposed knitting zones I and II. Zone I corresponds to the tubular part knitted with the machine rotating continuously. Zone II similar to zone IV of fig. 15 is also knitted by reciprocating process according to the method of fig. 1.

The method described has the advantage of permitting the mass production of knitted wearing articles, in an entirely automatic manner and without any waste as is the case when one cuts out pieces adapted to be sewn together.

The article produced also has the advantage of being formed of a single piece without side-seams.

#### WHAT WE CLAIM IS:—

1. A method of manufacturing a knitted garment having at least one tubular part and fashioned non tubular parts, said method being characterised by the steps of knitting said tubular part of the blank in circular continuous process on a circular knitting machine which has at least two opposite knitting stations and of knitting on said machine by a circular reciprocating process said non tubular parts suitably fashioned by narrowings by dropping stitches and by widenings by means of fresh stitches, said non tubular parts being knitted simultaneously on separate knitting stations.

2. A method according to claim 1, characterised by the step of forming, during the circular reciprocating movements, at least one pouch on a non tubular part of the blank, by narrowing courses with held stitches and widening courses by picking up said held stitches.

3. A circular knitting machine for manu-

facturing a knitted garment according to the method of claim 1, comprising a needle cylinder, knitting cams controlling the vertical movement of the needles, means for changing the movement of the machine from continuous to reciprocating, and means for the automatic change of the loop quality, characterised by further including means for putting all the needles into action for continuously knitting the tubular parts of the garment and means for selectively putting needles and groups of needles into and out of action for knitting in a reciprocating manner profiled parts of the garment and, to this end, comprising four selection channels each corresponding to a specific position of the needles.

4. The machine according to claim 3 wherein the knitting cam devices are arranged so as to bring selectively at least part of the latch needles into four different positions, the first corresponding to a waiting position wherein a stitch is kept under the latch, the second to an inoperative position, the third corresponding to the working position wherein the old stitch is engaged on the shank of the needle under the open latch, the needle being ready to collect fresh yarn to form new stitches and the fourth position also inoperative, for which the needles have dropped their last stitches.

5. A knitted garment obtained by means of the method according to claim 1, characterised by being formed of a single knitted piece comprising at least one tubular part integral with selvedge-profiled non-tubular parts with widenings and/or narrowings formed respectively by fresh stitches and and dropped stitches.

6. The article according to claim 5, comprising a selvedge-profiled non-tubular part having at least one pocket forming a gusset for a portion of the user's body.

7. The article according to claim 5, comprising at least one strengthened zone.

8. A knitting machine substantially as hereinbefore described with reference to and as illustrated in the accompanying drawings.

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& ROLLINSON,  
Chartered Patent Agents,  
Agents for the Applicants.

FIG. 1.

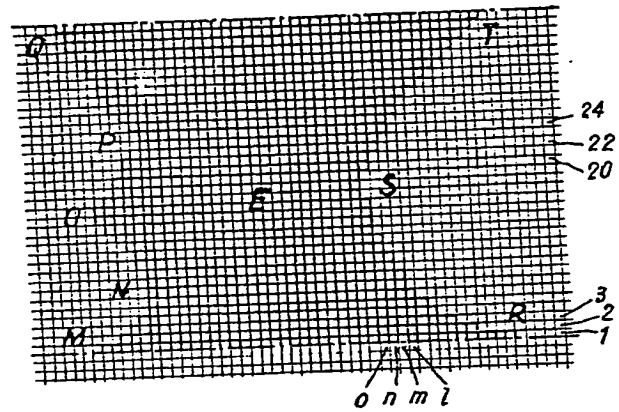


FIG. 3.

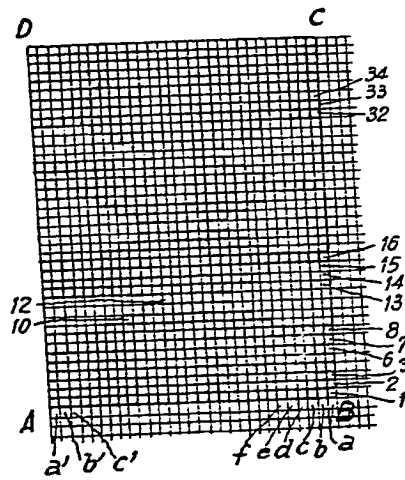
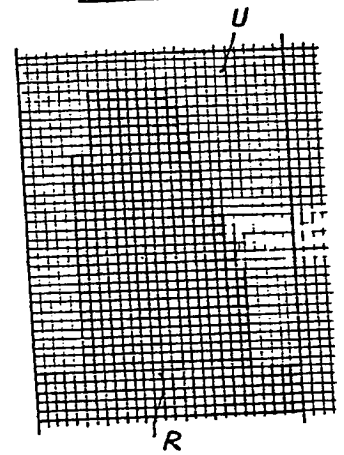


FIG. 2.

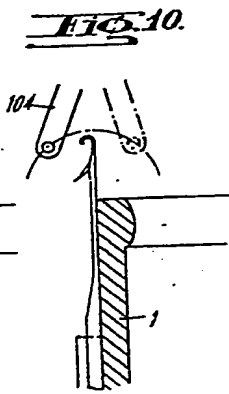
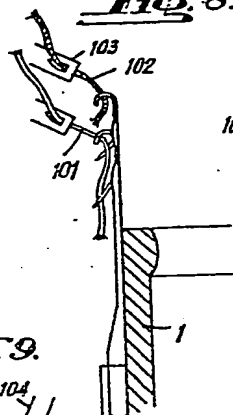
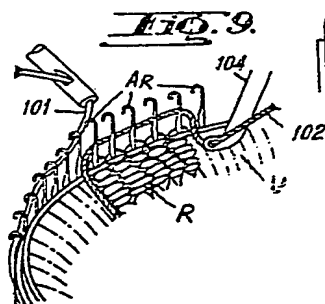
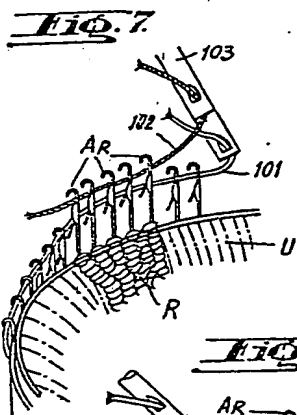
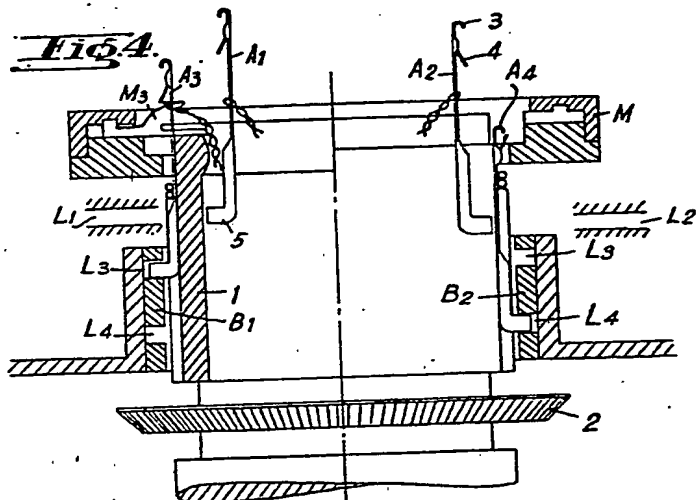
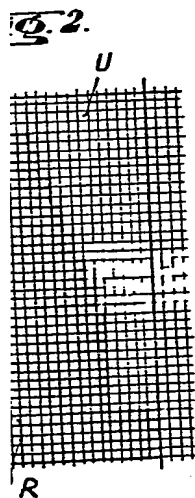
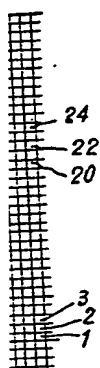


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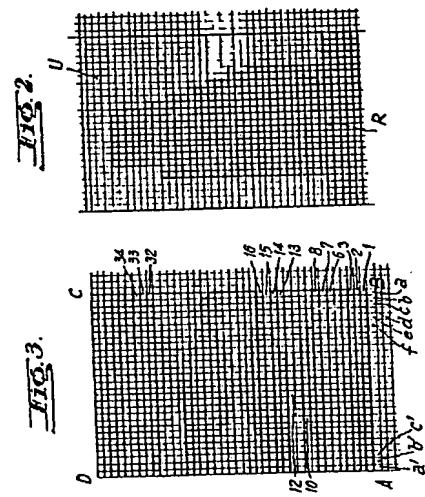
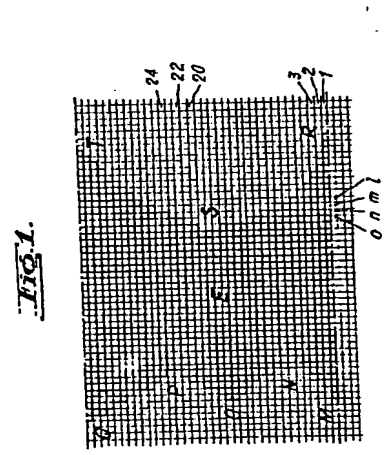
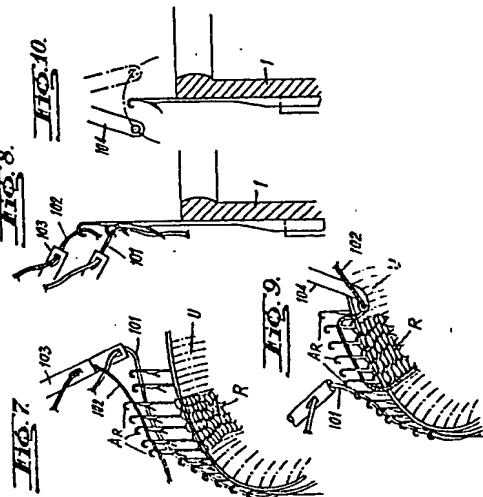
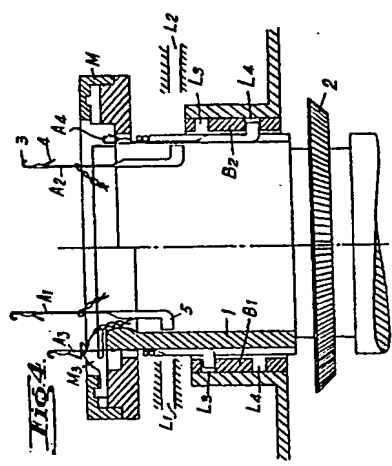
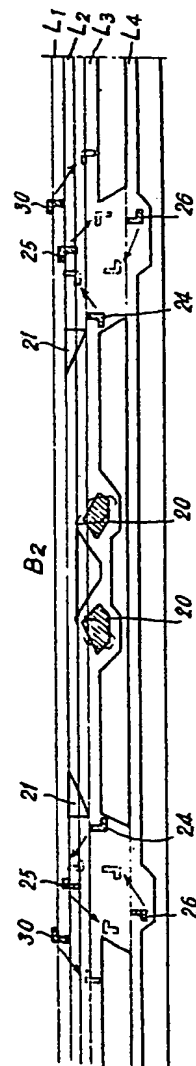
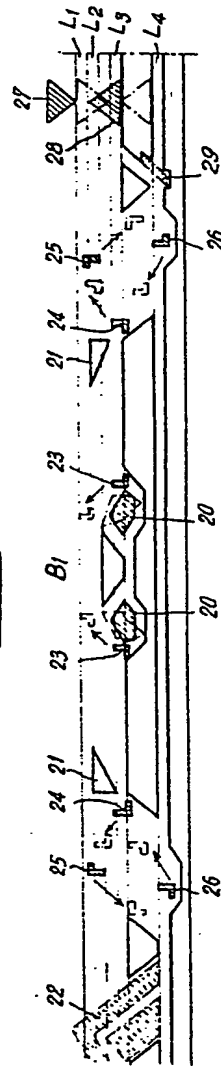


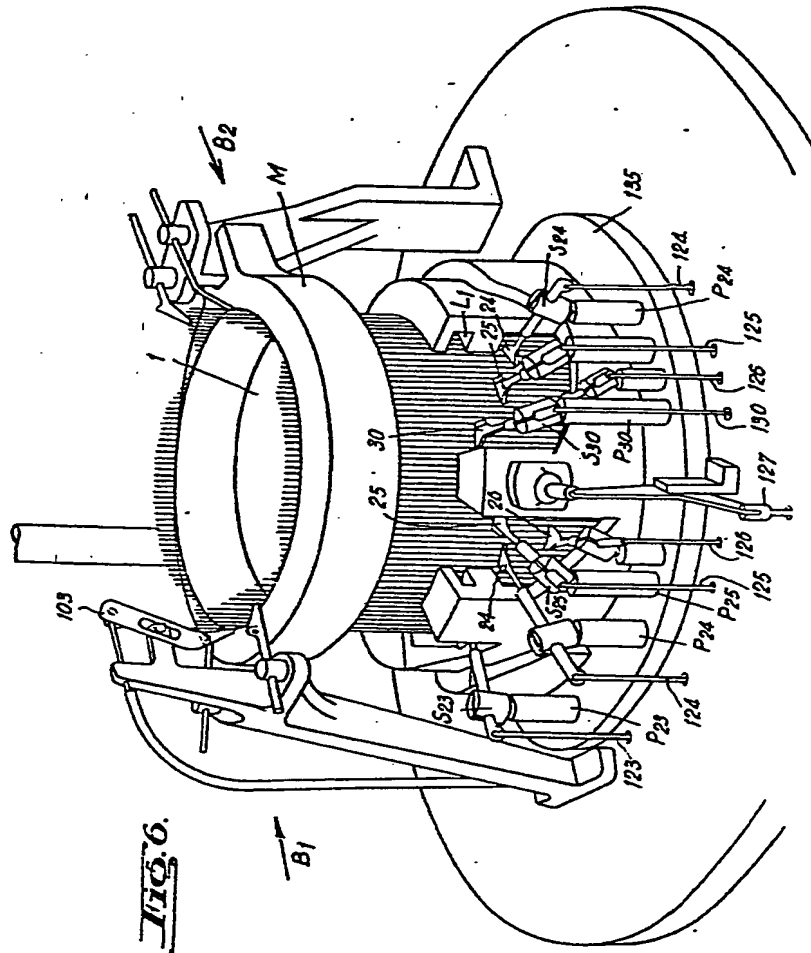


Fig. 5.



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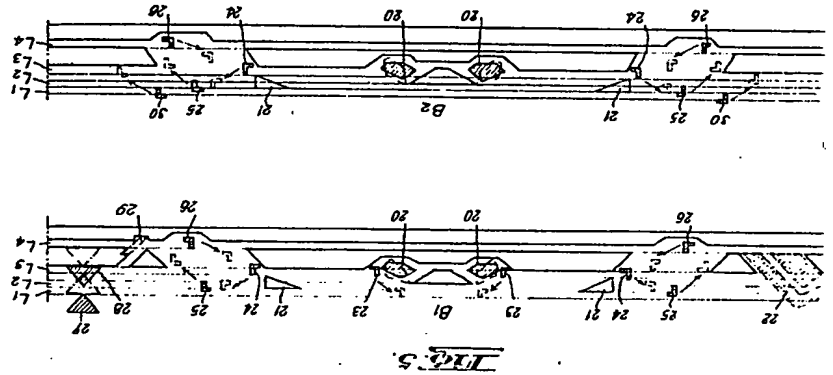
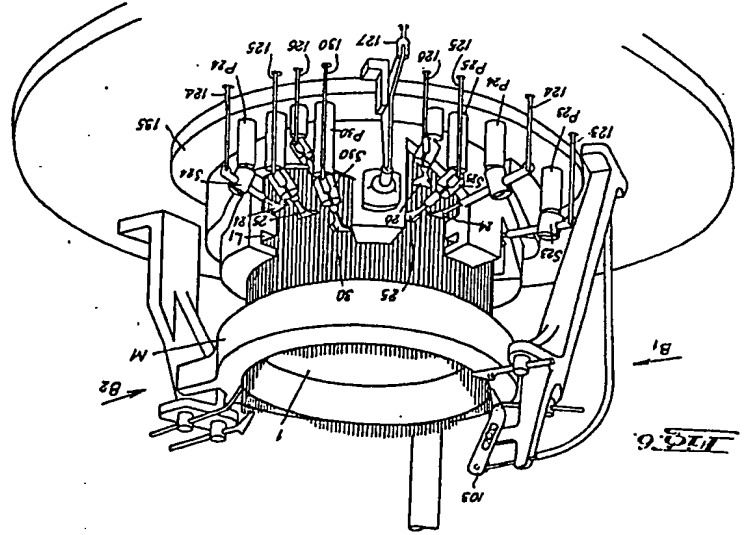


FIG. 11.

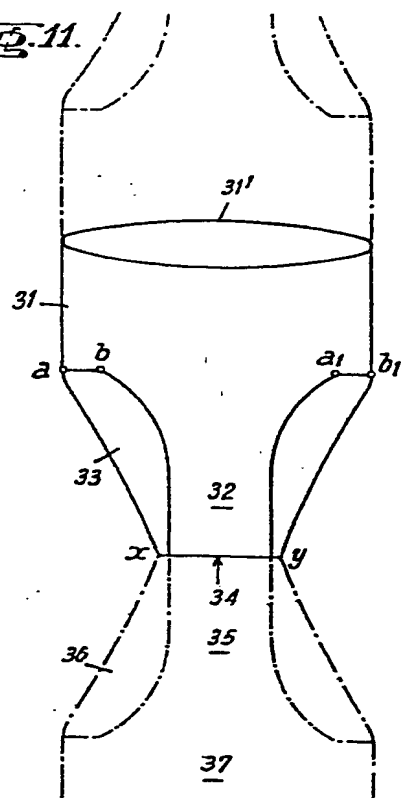


FIG. 12.

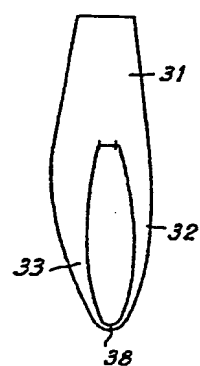


FIG. 13.

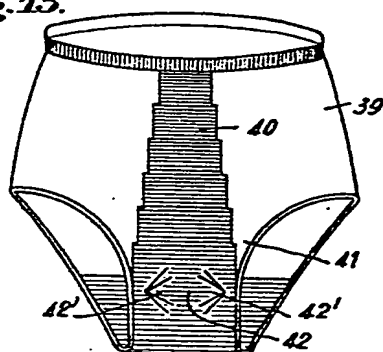
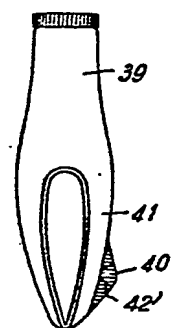


FIG. 14.



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Fig. 15.

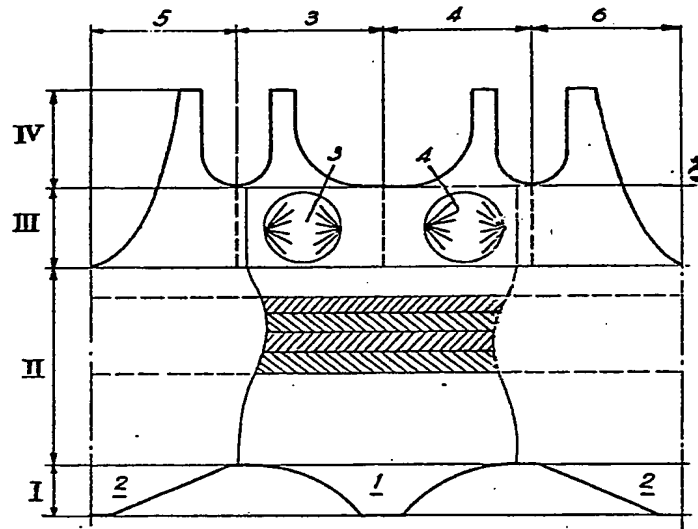


Fig. 16.

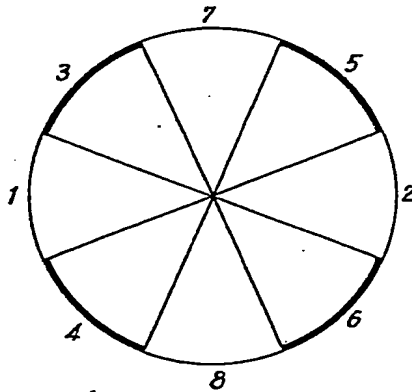
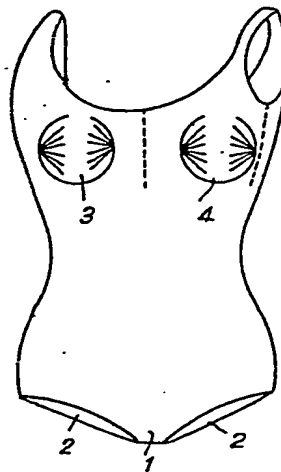


Fig. 17.



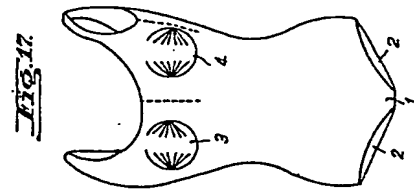
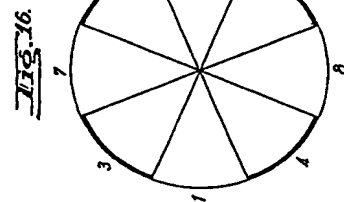
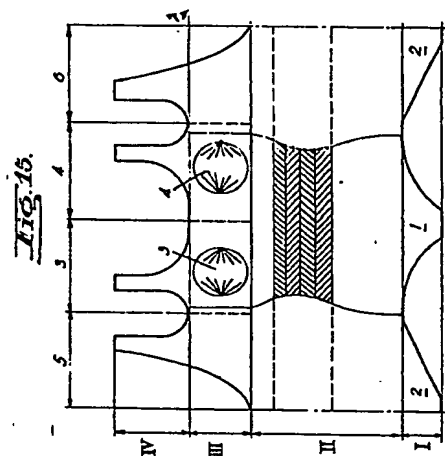
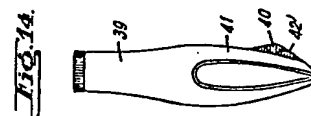
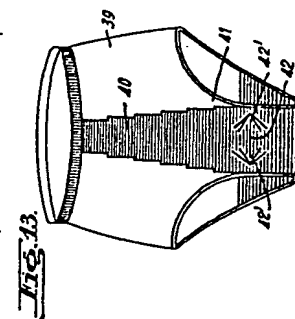
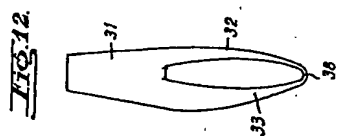
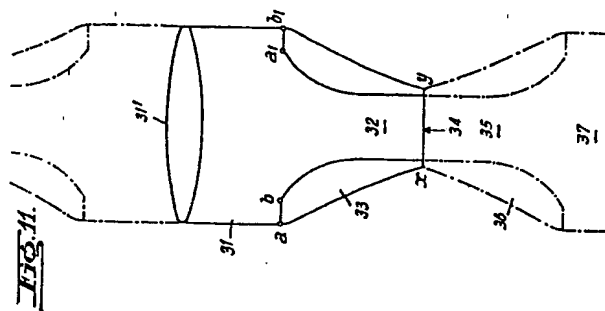


Fig. 18.

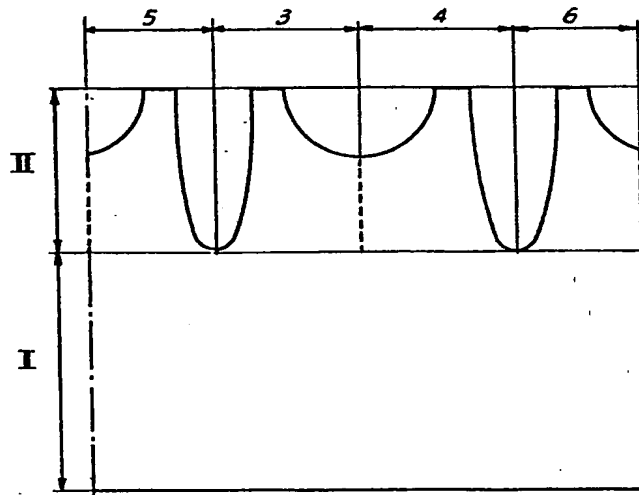
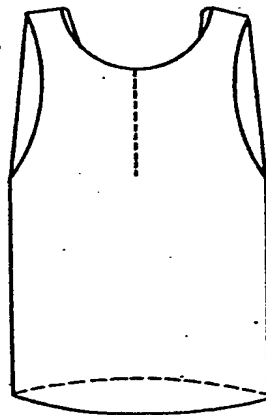


Fig. 19.



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